

NASA TECH BRIEF

Lewis Research Center



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High-Speed, Self-Acting Shaft Seal (Circumferential Type)

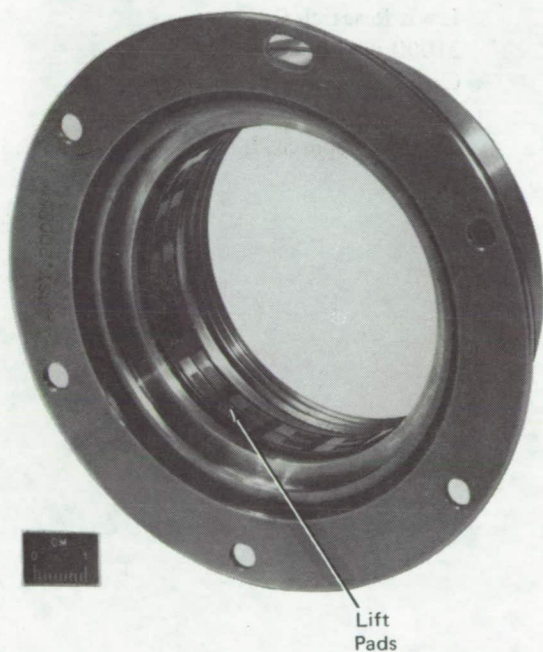


Figure 1

The problem:

To produce shaft riding circumferential seals which are capable of operating satisfactorily at the pressure and speed conditions of advanced turbine engines. Conventional circumferential type seals, because of rubbing contact and resulting high wear, cannot operate at the pressure (up to 138 N/cm^2) (200 psi), temperature (810 to 922 K) (1000°F to 1200°F) and speed (122 to 213 m/sec) (400 to 700 ft/sec) requirements of advanced engines.

The solution:

Add gas bearing lift pads to the bore of the circumferential seals (Figure 1). These lift pads establish a gas film between the seal bore and the rotating shaft. Thus, rubbing contact only occurs at the start and stop and heat generated by rubbing contact is eliminated.

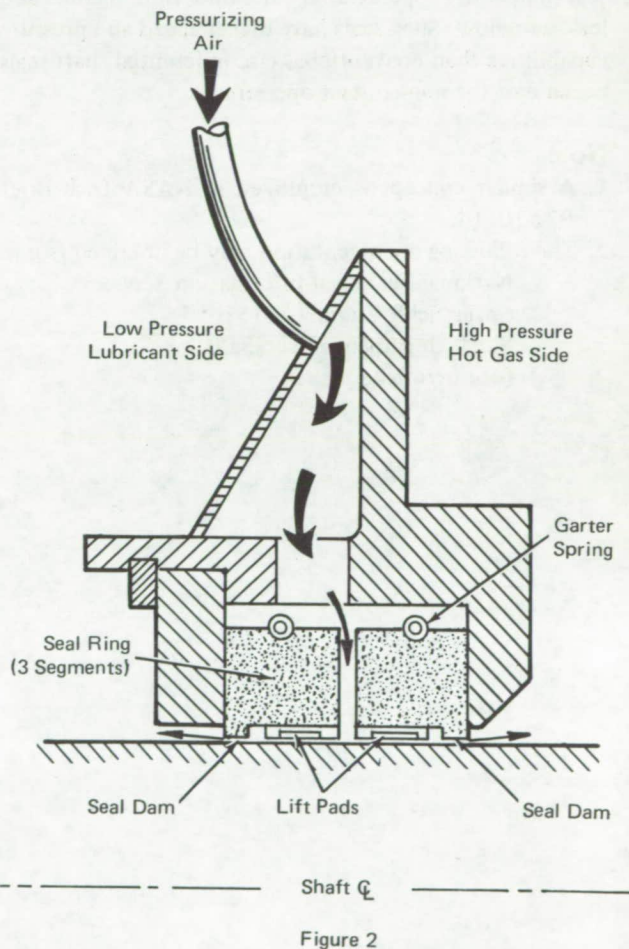


Figure 2

This permits the circumferential seal to have significantly greater pressure and speed capabilities than those of the conventional circumferential seal.

How it's done:

Figure 2 shows a conventional seal with carbon ring segments that ride on the rotating shaft. The bore has a groove pattern that permits the radial pressure forces to

(continued overleaf)

be partially balanced out. The sealing dam is a narrow ridge as shown in Figure 2. The seal consists of two segmented rings pressurized with air. The air leaks from the center of the seal across the left segment on the bearing side and also across the right segment on the hot gas side. Thus, oil is prevented from leaking out and hot gas is prevented from leaking into the bearing compartment.

To create a self-acting seal, a conventional seal is modified by adding the gas bearing lift pads. These lift pads have a lift force inversely proportional to gas film thickness. At small gas film thicknesses, typically 0.0003 cm (0.0001-inch), significant force is produced to separate the rubbing surfaces. As the film thickness increases, the lift force drops off rapidly. Thus, the seal inherently operates in the thin film regime and leakage is low. Such seals have higher speed and pressure capabilities than conventional circumferential shaft seals because of the non-contact operation.

Notes:

1. A similar concept is employed in NASA Tech Brief B72-10114.
2. The following documentation may be obtained from:
National Technical Information Service
Springfield, Virginia 22151
Single document price \$3.00
(or microfiche \$0.95)

Reference: NASA TN-D-5744 (N70-24256),
Design Study of Shaft Face Seal with Self-
Acting Lift Augmentation, I-Self-Acting Pad
Geometry.

3. Technical questions may be directed to:
Technology Utilization Officer
Lewis Research Center
21000 Brookpark Road
Cleveland, Ohio 44135
Reference: B72-10447

Patent status:

Inquiries about obtaining rights for the commercial
use of this invention may be made to:

Patent Counsel
Mail Stop 500-311
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(LEW-11274)